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ANALYSIS OF PARBOILED RICE PROCESSING IN NORTHERN REGION OF GHANA: DETERMINANTS, CONSTRAINTS AND OPPORTUNITIES

 Abdulai
Adams^a †,

 Emmanuel
Tetteh Jumpah^b,

Kehinde Damilola
Ilesanmi^c,

Hajei Douri Bennin^d

^a † Research Scientist; CSIR - Science and Technology Policy Research
Institute, Accra, Ghana

^b Principal Technologist; CSIR - Science and Technology Policy Research
Institute, Accra, Ghana

^c Postdoctoral Fellow; Faculty of Commerce, Administration and Law,
University of Zululand, Kwa Dlangezwa, 3886, South Africa

^d Executive Director; Youth Advocacy on Rights and Opportunities,
Tamale, Ghana

† ✉ boginah@yahoo.com (Corresponding author)

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ABSTRACT

This paper aims at understanding the current dynamics that underlie the parboil rice industry in the Northern Region of Ghana and the analysis focuses on the determinants, constraints, and opportunities. Study utilise recent primary data collected (March-April 2019) from 270 rice processors across two districts purposively selected. Quantitative analysis was done using Probit and non-parametric methods to identify determinants and rank constraints associated with local rice parboiling. The findings revealed that rice parboiling is the primary activity of women and Jasmine and AGRA rice is the most commonly varieties processed. Grades and standards for parboiling rice exist but enforcement in the marketplace is weak. Education level, age and experience of processors are the key determinants of rice parboiling in the Northern Region. Inadequate technical know-how, low capacity of processing equipment, lack of grades and standards, general low prices and demand, and lack of finance are the main constraints hindering the proper development of the local rice industry and efficient participation of households in markets. Emerging opportunities in the sector which women and youth could take advantage for better livelihoods includes sale to institutions (schools, prisons, and hospitals), packaging, and the government input subsidy programme.

Contribution/ Originality

There are limited studies that examine the performance of the local rice industry in Ghana, especially on rice parboiling and the constraints and opportunities associated with it. This paper bridges the gap by providing insights into the dynamics and nature of constraints facing the rice parboiling sector. Opportunities exist locally for exploitation to help upgrade the quality of local rice for an improved standard of living. We declare that this paper has never been published before and is not under consideration with any other Journal for that purpose.

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1. INTRODUCTION

Ghana has a great potential for self-sufficiency in rice production. In the 1970s, the policy of self-sufficiency by the government facilitated the production of rice in the country. The country has witnessed sustained increases in both rice production and productivity since 2013. For instance, rice productivity increased from 2.64 MT per hectare in 2013 to 3.01 MT per hectare in 2017 (MOFA, 2017). The increased trajectory has largely been attributed to increased adoption of technologies, access to and use of input, enhanced extension delivery, and availability of improved planting materials. Northern Ghana has a vast potential for rice production and accounts for 61% of the total rice produced in the country (MOFA, 2016). Rice production and processing are profitable ventures (Islam *et al.*, 2017; Wireko-Manu and Amamoo, 2017; Bwala and John, 2018; Akter *et al.*, 2019) and the industry offers a huge potential to eliminate poverty if significant investments are made to address constraints.

Several national policies and programmes are being developed and implemented by African governments aimed at increasing domestic rice production and reducing import, and Ghana is no exception. However, many of these programmes and strategies are production focused with little emphasis on the entire rice value chain (Demont, 2013). In Ghana for instance, the Rice Sector Support Project (RSSP) intervention being implemented by the Ministry of Food and Agriculture (MOFA) is anticipated to support the development of 6,000ha of lowland rice production and milling of 16,250MT per annum. However, linking processors to marketers/or markets, and packaging to meet the needs of consumers is missing in the programme targets. There is urgent need to commercially connect local rice value chains to national rice sector development hubs for greater efficiency.

Interventions by state and non-state actors to revamp the rice sector over the years has not yielded the desired impact as domestic production cannot still meet demand as a result of population growth and inefficiency in the sector. On the other hand, changing taste and preferences in consumer coupled with the uncompetitive nature of rice mills has led to high import rice bills in the country. In northern Ghana for instance, the market share for imported rice stood at 76% compared to 24% for local rice (Tanko, 2016). Constraints faced by the local rice industry which makes it less competitive includes high production and processing costs, difficulty in obtaining credit, poor quality of local rice, poor packaging, and limited use of advanced technologies in processing. Poor farm management practices (late harvesting, water logging), post-harvest practices by farmers (harvesting, threshing, drying, and storage of paddy), poor extension service delivery coupled with the use of sub-standard processing infrastructure in rice milling contributes to the poor quality of local rice (Manful *et al.*, 1998; Seck *et al.*, 2010; Nwalieji, 2016). Grading techniques and grading attributes are essential in rice milling as it ensures that the quality standards demanded by consumers are met (ChePa *et al.*, 2016). However, ensuring greater quality remains a challenge to the local milling sector, hence low prices and demand for the product. As noted by Ayeduvor (2018), the perceived low quality for local rice is reflected in the low prices received compared to imported rice of the same quality in Ghanaian markets. The commercial distribution of local rice is also unstructured and this impacts on the marketing. The main criteria for grading rice are the degree of milling, content of broken rice, grain length, and the content of head rice (BERNAS, 2011).

Both socio-economic and quality factors influence households' preferences for local rice in Ghana (Ahiakpor *et al.*, 2017). While income, age, sex and marital status significantly influences household's preference for local rice in the Upper East Region, packaging, the absence of foreign materials and aroma play a significant role. Key traits considered by consumers in their choice for local rice are grains with good appearance, well packaged, and the absence of contaminants. In assessing the quality of local rice that influences their consumption in Ghana, Ayeduvor (2018)

found improvements in the quality of branding for local rice types in recent times though some are still not branded and the presence of foreign materials remains a challenge.

Despite the nutritional, economical, and better sensory advantages of parboiling rice compared polished rice (Rocha-Villarreal *et al.*, 2018) only few people are involved in the processing and marketing of parboil rice. Parboiling significantly improves head rice recovery, the physical appearance, eating, nutritional quality, and could compensate for the weakness in farmers and millers post-harvest practices (Ndindeng *et al.*, 2015). The key questions raised are: 'what factors influence the decision of processors to participate in the rice parboiling business and what constraints and opportunities exist in the industry? Analysing the dynamics that underlie local rice production in the Northern Region is relevant as it contributes to bridging the knowledge gap in rice parboiling and how to improve the quality, an area that has received less attention in the rice literature. The constraints and opportunities highlighted, has greater policy implications in making the local rice sector competitive and creating decent jobs along the rice value chain.

2. LITERATURE REVIEW

2.1. Factors influencing consumer preference of rice

Consumer preference for local rice is driven by several factors and in terms of pricing, a long run relationship exists between imported and local rice in regional and district markets (Tanko, 2016). Domestic prices for rice response to price shocks in the long run and local rice producers are not price takers as traders selling imported rice do not lead in price setting. As a policy measure, there is the need to make local rice more competitive (improve standards), creating more awareness among target groups on the quality and quantity of domestic rice available in local markets, and probably imposing higher tariffs to reduce rice imports to create demand for local rice are advocated for.

Moseley *et al.* (2010) attributed Mali's success from less dependence on imported rice to a mix of price and non-price factors. Improving internal networks for local rice, landlocked status which facilitates domestic rice production, generating more financial space for the national rice sector to thrive, less competition faced by local rice in terms of quality, strong desire by consumers for local rice, and the willingness of people to pay a higher price premium for local rice varieties contributed to rice self-sufficiency (Moseley *et al.*, 2010; Demont *et al.*, 2013; Demont, 2016).

Recent studies have espoused the centrality to upgrade rice value chains to effectively deal with the demand side issue and ensure rice self-sufficiency especially in large urban consuming centres in Africa (Demont, 2013; Wailes *et al.*, 2015; Gyimah-Brempong *et al.*, 2016). Historically, the continent is noted for increasing rice imports resulting in a biased preference shift for local rice in favour of Asian rice quality standards, a situation that makes it difficult for local rice to compete (Demont and Ndour, 2015; Coulibaly *et al.*, 2015; Demont *et al.*, 2017). Consumer appreciation for Asian rice attributes, access to free port, as well as geographic distance explains the increasing difficulties for local rice to favourably compete with imported rice (Demont *et al.*, 2017). Aiming to attain rice self-sufficiency would therefore require simultaneous upgrading of rice quality and value chains (Wailes *et al.*, 2015). Other policy measures proposed in dealing with the rice imports are the imposition of higher tariffs, marketing campaigns and consumer awareness raising, and improving the quality of local rice (Tanko, 2016; Ayeduvor, 2018). Increasing investments through public support also have great potential of inducing higher prices for local rice in domestic markets with positive returns.

In addition, studies that focus on analysing consumer preferences for local rice and their willingness to pay higher premiums have revealed mixed findings (Fiamohe *et al.*, 2015; Diagne *et al.*, 2017). Generally, urban consumers in West Africa prefer imported rice to local rice and the

willingness of consumers to pay a higher premium is based on the attributes of cleanliness and whiteness (Fiamohe *et al.*, 2015; ChePa *et al.*, 2016), aroma/fragrance (Diagne *et al.*, 2017), and local/relative rice (Asante *et al.*, 2013). However, a study conducted by Demont *et al.* (2017) did not find the aroma to be a significant attribute that shapes the choice of consumers for local rice. Their findings suggest that the failure to upgrade the quality of local rice to the standards of imported rice affects the demand for local rice. Other quality attributes of rice that influences consumers choice for imported rice over local rice includes the absence of contaminants, ease of cooking, better grain quality (Asante *et al.*, 2013), taste, cooking time, and cooking quality (Anang *et al.*, 2011; Ahiakpor *et al.*, 2017). This suggests that, consumers demand for rice is driven by multiple factors with price and quality variables playing key roles in the market.

Socio-economic, quality factors, and policy constraints affect rice production, processing and consumption in sub-Saharan Africa (Ahiakpor *et al.*, 2017; Balamurugan and Balasubramanian, 2017). Input and output market constraints, limited access to credit, poor rural transport and infrastructure are the issues. Furthermore, high post-harvest losses, poor quality of milled rice, and high production cost are some of the biggest challenge facing African rice farmers (Balamurugan and Balasubramanian, 2017). Reducing unit costs at the farm and off-farm levels of the rice value chain could positively impact on future developments in the sector (Adjao and Staatz, 2015). Quality improvement, managing risks, and the promotion of locally suitable technologies holds the promise to increase local rice production. Lack of a comprehensive national policy plan for the rice sector and coherence in program implementation to tackle the numerous constraints and observed deficiencies remains an issue.

Meanwhile, the demand for more expensive rice varieties by consumers is on a growth trajectory because of the high premium placed on off-farm activities, especially milling, retailing, and branding (Minten *et al.*, 2013). In analysing the implications of food quality changes in Bangladesh, the authors reported that the rewards for labour in producing different varieties of rice were the same and that farmers enjoy no direct benefits from the increased willingness of consumers to pay more for rice.

Custodic *et al.* (2016) analysed the differences and trends associated with consumer choices for intrinsic rice attributes in 24 cities across 7 countries in Asia. The study highlighted the need to incorporate rice attributes preferred by most people into rice breeding programmes while taking into account geographic differences and specific preferences as a way of improving the food security situation. While reducing yield gaps and expanding areas cultivated to rice hold the key to substantially increase paddy production (Seck *et al.*, 2010), branding, advertising, and promotional events are central to uplifting demand for local rice (Demont, 2013; Demont *et al.*, 2017). Furthermore, Demont *et al.* (2017) emphasised the need for specific targeting of promotional events to larger households and female shoppers for greater consumption effects. Marketing, therefore, offers a great opportunity for the realization of African countries a large potential for rice production.

Recent increases in rice production in sub-Saharan Africa have been linked to commercialization. Domestic policies are focusing to improve market access and performance especially for smallholder farmers, and promote inclusive participation (Nasrin *et al.*, 2015). A study on rice commercialization in Ethiopia showed that majority of farmers mainly sold their paddy to local processors whom they build long term relationships with. Farmers were, however, not very happy with the arrangement due to low prices obtained and the observed manipulation of scales by some processors (Alemu *et al.*, 2018).

Analysing the operations of 140 rice farmers in Bangladesh, Akter *et al.* (2019) found rice production profitable since the returns exceeded the production cost. However, profitability levels

were found to differ across different farmer groups and large-scale farms are more profitable than small and medium sized farms. The main determinants of profitability revealed were fertilizer cost, the cost of power tiller, and hired labour cost. In addition, rice processing has also been found profitable (Johnson and Masias, 2016; Chung *et al.*, 2016). An analysis of rice mills in Malaysia revealed long run profitability in milling though there is subsidy effect on the profit margin. Rice mills that received miller subsidy were more protected than those that do not benefit from such intervention. Furthermore, large private mills enjoyed higher profit margins due to economies of scale. However, paddy price, the recovery ratio, and changes in paddy purchases influences profitability (Chung *et al.*, 2016). Johnson and Masias (2016) assessed the performance of rice mills in Nigeria in the light of government's growth and agriculture modernization agenda. The findings revealed governments' success in expanding both the quality of paddy produced and milling capacity of medium and large-scale firms. This has accelerated the capacity of the mills to utilize paddy (rice milling rose by 0.5 million MT) and produce quality rice for consumption. This suggests that expanding quality paddy supply to mills could lead to self-sufficiency in rice production. However, overall increase in employment in the industry was minimal and the study did not factor the role of small-scale millers in the analysis.

3. METHODOLOGY

3.1. Population and sampling

The population for this study is made up of rice processors (parboiled and non-parboiled) in the Kumbungu and Sagnarigu districts of Northern Region. The Northern Region was chosen for this study because it accounts for over 61% of the total rice produced in the Country and rice parboiling is dominant in the two districts considered. Both primary and secondary data were collected and analysed as part of the study. A list of rice processing groups compiled by ARMSIG Resources, a local NGO engaged in rice parboiling was used as the basis for determining the sample. The list which was updated in 2018 has a total of eight groups with 365 individual members actively engaged in rice parboiling and marketing. A total of five groups were selected based on their current level of operations and activities. Groups which were more active and vibrant in their processing activities were purposively selected and 150 rice parboilers randomly selected. For non-parboiler, the total population was 183 individuals and assuming a confidence of 95% translated into 125. Data was collected using a semi structured questionnaire, and after cleaning the number of non-parboilers dropped to 120. The distribution of the sample selected is captured in Table 1. Concentration of rice processing activities and population density were taken into consideration on the number of respondents allocated to each community.

Table 1: Sample distribution

District	Communities	No. Sampled
Kumbungu	Kpachi	51
	Kunkulung	72
	Wuba	43
Sagnarigu	Garizegu	43
	Sligu	37
Total		270

The information collected covers socio-economic and demographic data, production and processing data, financing, grading and standardization, marketing, constraints and opportunities. Secondary data on prices was collected from the District Department of Agriculture which was used to validate some of the responses given by processors.

3.2. Model specification and data analysis

The quantitative data collected was analysed using LINDEP version 10 econometric software. The study utilised the probit model in analysing the factors that influence processors' choice of rice processing. Theoretically, the decision of a processor to do parboiling is influenced by certain factors (individual, demographic and institutional). Let the latent variable, Y_i represent the decision of a processor to do parboiling as her main occupation for livelihood and X_i represents independent variables, the quantitative response model can be written as:

$$Y_i = \alpha + \beta X_i + \mu_i \quad \dots\dots\dots (1)$$

where α is the constant, β is the coefficient of parameters to be estimated, and μ_i is the error term. For discrete choice models of this nature, the Ordinary Least Squares (OLS) technique is inappropriate and cannot be applied since the probability of an event occurring is non-linear in nature (Collet, 1991). Heteroscedasticity of the error terms coupled with estimated probability values that lie outside the usual range [0 and 1] could arise if OLS is applied. The use of logit or probit models offers a plausible solution. However, the probit model performs better in small samples relative to the logit (Anang *et al.*, 2015; Sebopetji and Belete, 2009), hence the choice for the probit model.

The probit model is specified as:

$$\text{Probability}(Z_i = 1) = \Phi(X_i \gamma) \quad \dots\dots\dots (2)$$

where Z_i is the binary choice variable (0 or 1), Φ depicts the Cumulative Distribution Function of the standard normal distribution, γ represents unknown parameters to be estimated, and X_i represents the explanatory variables included in the model.

Probit models often produce estimates that lie between 0 and 1 (constrains probabilities) but poses a relaxed condition on the effects of explanatory variables on the predicted values of the dependent variable. The basic assumption is that only the values of 0 and 1 are observed for the dependent variable, but that a latent continuous variable Z^*_i exists which determines the value of the dependent variable, Z_i (Sebopetji and Belete, 2009). Z^* is given as:

$$Z^*_i = \gamma_0 + \sum_{n=1}^N \gamma_n X_m + u_i \quad \dots\dots\dots (3)$$

where N = sample size and $Z_i = 1$ if $Z^*_i > 0$; and $Z_i = 0$ otherwise.

The empirical model which was estimated following maximum likelihood procedures is of the form:

$$Y_i = \beta_0 + \beta_1 AGE_i + \beta_2 MST_i + \beta_3 HHS_i + \beta_4 EXP_i + \beta_5 EDC_i + \beta_6 OCC_i + \beta_7 ASM_i + \varepsilon_i \quad \dots\dots (4)$$

Where,

Y_i = Dependent variable which is binary (parboiling of rice by a processor),

β_0 = Intercept

$\beta_1 - \beta_7$ = Coefficient of parameters to be estimated

AGE = Age of respondent in years

MST = Marital status

HHS = Household size

EXP = Years of experience in rice processing

EDC = Level of education

OCC = Main occupation of processor

ASM = Membership to a group, and

ε_i = Random error term.

To understand the key constraints facing rice processors, Kendall's Coefficient of Concordance, a nonparametric approach was used to rank constraints identified to be associated with rice processing and marketing in the districts. This approach has been widely used in assessing the level of agreement among a set of observations by providing ranks. A list of constraints based on literature search was provided to respondents and each processor was asked to rank the constraints (from the most important to the least important) based on the level of importance they attach to them in their operations. The sum of ranks was then computed though most empirical studies utilise the mean rank. Kendall Coefficient of Concordance (W) is given as:

$$W = \frac{12S' - 3p^2(n+1)^2}{p^2(n^3 - n) - pT} \dots\dots\dots (5)$$

Where P = number of observations, n = number of constraints ranked, S = sum of squares, and t = correction for tie. The value of W is tested using the chi square, $X^2 = p(n-1)W$, with the null hypothesis of no agreement in the ranks of the constraints as provided by the observations. Based on the level of significance, a decision to accept or reject is then made. If significant, then the null hypothesis is rejected.

4. RESULTS AND DISCUSSIONS

4.1. Socioeconomic characteristics of respondents

The variables considered in this study, their definitions and measurement, and a summary of the descriptive statistics are discussed here. The mean age of processors was 46 years, but the age structure varies from 25 years to 51 years. The future of the parboil rice processing in the area does not seem sustainable since young females involvement in the sector is minimal. About 94% of respondents covered were married, a sign of independence and maturity as cultural norms in the area reflects. The mean household size of the sample surveyed is 8 but varies widely from a membership of 2 to 20 people. This reflects the demographic profile of households in northern Ghana which are said to be larger in size. The average experience level of processors was 7 years with the maximum being 45 years. This is good enough to make processors more efficient as learning curve effects occur within the sector. Education is a key factor in business development. However, most processors did not have formal education and when they do, it was below the tertiary level. About 85% of processors were engaged in rice parboiling as their main occupation. The study found that females were engaged in rice processing and marketing while males are mainly focussed on production. Furthermore, 96% of processors were members of a production/processing/marketing groups or groupings such as the Village Saving Loan Associations (VSLA). This is important due to the social and economic benefits likely to be derived for belonging to such associations. In addition, about 65% of the processors were undertaking value addition activities such as packaging, and promotions to expand markets for their products.

4.2. Determinants of rice parboiling

Results of the analysis on factors that influence rice parboiling is presented in Table 2. The values of the Pseudo R-squared and that of the chi-squared shows that the model is well fitted to the data set.

Table 2: Probit estimates of the determents of rice parboiling

Variable	Variable definition	Coefficient	Standard Error	Prob. z >Z*
AGE	Age of processor in years	-0.057**	0.026	0.028
MST	Marital status	-0.368	0.745	0.622
HHS	Household size	-0.014	0.063	0.998

EXP	Years of experience in rice processing	0.067**	0.031	0.029
EDC	Level of education	-0.061***	0.550	0.913
OCC	Main occupation	1.449	0.992	0.145
ASM	Membership to a group	-0.362	0.725	0.618
<i>Goodness of fit</i>				
No. of Objects = 270; Pseudo R ² = 0.667; Chi ² (6df) = 110.46; P-value = 0.011; Log Likelihood Function = -126.04				

Source: Authors' own estimation from field data

Note: ***, **, and * represents 1%, 5%, and 10% level of significance

The coefficient for age is negative and statistically significant, suggesting that as processors age, their level of participation in rice parboiling decline. This may be because older people are generally risk averse and such adoption of new ideas and technologies in processing and marketing methods may decline with age. This could be attributed to the generally low adoption to new things which older people use to minimise risk in their business operations. The recent shift in focus to the youth following the unemployment situation in the country could also mean that less attention is being paid to older people in the rice industry. This finding is similar to previous evidence by [Musa *et al.* \(2011\)](#) who found age to be a significant determinant of the purchasing behaviour of rice consumers in Malaysia. In the Upper East Region of Ghana, [Ahiakpor *et al.* \(2017\)](#) found age to significantly influence households' preferences for local rice. Female involvement in the rice value chain needs to be supported through investments in the sector.

Both marital status and household size are found to have negative coefficients and statistically insignificant, suggesting that these factors do not influence rice parboiling decisions in the area. Experience, which is measured as the number of years of processors has been in rice parboiling business has a positive and significant effect on the decision to parboil. This suggests that as females stay longer in the industry their attitude toward the adoption of new processing and marketing methods improves due to learning curve effects.

The level of education attained is negative and statistically significant in influencing rice parboiling decision. As level of education increases the decision to do parboiling business declines. This may be due to the low profitability of the sector which may compel more educated people, who may have better job options to leave the business. This outcome contradicts earlier findings by [Anang *et al.* \(2016\)](#) that formal education increases the technical efficiency in rice production. The occupation of processors is also irrelevant and does not influence the uptake of processing and marketing methods in any way. Even though, these women were members of rice processing groups in their communities, individuals were not deriving the needed benefits for their membership since the coefficient of the variable is negative and insignificant. This is in sharp contrast with the findings of [Dandedjrohoun *et al.* \(2016\)](#) that being a member of a parboilers association increases processors knowledge and adoption of technology. Membership to a farmer association improves the technical efficiency performance of rice farmers ([Anang *et al.*, \(2016\)](#)). There is need for members to engage in collective marketing activities so that economic benefits can trickle down to members as a result of their being together in an association.

4.3. Constraints to processing and marketing local rice

Rice parboilers are faced with several processing and marketing constraints which contribute to making the local industry non-competitive. Following extensive review of the literature and talking to experts in the sector, a list of constraints was identified (Table 3) and processors were then asked to rank these constraints based on their experience and operations. The mean rank for each constraint was then calculated and the rank determined. The Kendall's Coefficient of Concordance which tests the level of agreement among the rice parboilers of the constraints was estimated at

0.7987, having a Chi-Square of 196.12 with 8 degrees of freedom. Since the computed Chi-Square was greater than the Chi-Square critical at 1% significance, the study accepts the alternate hypothesis and rejects the null hypothesis. This implies that there was agreement among the rice parboilers about the challenges that confront their operations. W of 0.798 means that there was about 80% agreement among the rankings of the constraints of the rice parboilers.

Table 3: Constraints to processing and marketing of parboil rice

Constraints	Mean Score	Rank
Limited technical know-how	1.22	1 st
Low capacity of processing equipment	2.30	2 nd
Lack of grading and standards	2.33	3 rd
Low prices	4.46	4 th
Lack of finance	5.47	5 th
Poor market infrastructure	5.83	6 th
Low level of awareness among consumers	6.04	7 th
Poor road network	7.28	8 th
Poor quality	7.31	9 th
Measure of goodness of fit		
No. of objects = 150; Kendall's W = 0.799; Chi ² = 196.12; df = 8 Asymptomatic significance = 0.000		

The findings show that limited technical know-how is the main constraint facing local rice processors in the Northern Region. Technical knowledge on quality rice processing is currently limited among farmers and efforts by both government and NGOs to enhance the capacity of these people through training appears to be weak. In fact, only 14.67% of the respondents admitted receiving any form of training on rice processing for the past two years. Participation of parboilers in video training has been found to positively impact on the knowledge and use of improved parboiling vessels in Benin ([Dandedjrohoun et al., 2014](#)). Improving the quality standards of local rice to the level of Asian imports to make it competitive would require large public expenditure in not just equipment but more importantly on training ([Wailes et al., 2015](#)). Poor extension services visit to farmers and processors remains a major constraint in the rice sector ([Nwaleji, 2016](#)). The second identified constraint is the low capacity of processing equipment which manifests in reduced volumes. The average volume of paddy processed per week currently stood at 11 maxi bags. The potential to increase this volume and improve the quality exist if improved modern equipment is made available to processors. As noted by [Fofana et al. \(2011\)](#) the use of traditional equipment in parboiling results in high (90%) heat-damaged grains compared to the use of improved methods (17%). However, meeting the cost of improved processing vessels remains a challenge for most women parboilers. Although, small scale processors have been shown to earn lower returns compared to large scale mills ([Chung et al., 2016](#)), they are efficient in their operations and the government could consider introducing milling subsidy to make the sector more lucrative. The performance of rice mills especially among smallholder processing firms remains a challenge ([Johnson and Masias, 2016](#)).

Lack of grading and standards is ranked the third most pressing constraint facing the local rice processing sector. Inadequate regulations and weak enforcement could be the cause of lack of standardisation despite the fact that standardisation plays critical in ensuring the quality of rice processed and sold to the consumer. Rice processors play unique roles in rice commercialisation by providing processing and wholesale services ([Alemu et al., 2018](#)). However, manipulation of scales by some processors does not only reduce the incomes of farmers but contributes to inaccurate estimation of rice volumes bought and sold ([Alemu et al., 2018](#)).

Low prices which are reflected in low demand and lack of finance are ranked fourth and fifth respectively. Given the challenges of standardisation, it is no surprise that low price is another important constraint because standards will affect quality which intends will affect the price. As reported by [Ahiakpor et al. \(2017\)](#), good appearance, well packed and free from contaminants are the key traits that influence consumers' choice of local rice in the Upper East Region. Ensuring greater quality, is necessary for higher prices to be obtained ([ChePa et al., 2016](#)). To address the issue of low prices will require the use of multiple approaches such as adapting effective marketing strategies, improving the standards, exploring the use of external buyers, encouraging group marketing, linking processors to consumer groups and aggregators.

Lack of finance for processors, aggregators and other actors within the rice value chains is a major concern. Financing for parboiling rice processing is non-existent from formal sources and processors had to rely on friends, relatives and VSLA groups meagre loans to support their operations. As reported by [Nwaleji \(2016\)](#) inadequate funds for start-ups and difficulty in obtaining loans hinders the efficient production of quality rice. [Linn and Maenhont \(2019\)](#) noted that financial constraints impacts on infrastructure investment in rice value chains which make it structurally inefficient. Policy interventions aimed at addressing these constraints will greatly impact on the local rice sector and make it more competitive.

4.4. Opportunities for rice parboiling and marketing

Several opportunities exist in the districts which women and youth could take advantage of for better livelihoods. Key areas revealed through this study are discussed below:

- *Demand for local rice exist:* The demand for parboiling rice though slow is growing. Improving the quality and packaging it attractively in different sizes could further increasing demand for the commodity in domestic markets. However, upgrading the quality to appreciable levels of standards will not happen unless conscious efforts are made to uplift investment in the local rice value chain ([Wailes et al., 2015](#)). Increasing investment in post-harvest infrastructure and improving research and development on rice varieties preferred by consumers locally is thus critical in sustaining the local rice industry ([Custodic et al., 2016](#)).
- *Presence of the Ghana school feeding programme:* The school feeding programme which is currently running in most schools is a good avenue that can be used to create market for parboiling rice. A policy that makes it mandatory for suppliers under the school feeding programme to supply the majority or only parboil rice could go a long way in creating a market and demand for local rice. Also, linking processors to other government institution (such as hospitals, senior high schools, prison service) under contract supply agreements/arrangements could promote the consumption of local rice, improve incomes of processors, and trigger rice production in the country.
- *Presence of research institutions:* The Savannah Agricultural Research Institute (SARI) and the University for Development Studies (UDS) which are located in the Region can continue with the development and scaling up of improved rice varieties such as Jasmine and AGRA rice, which, because of their aromatic qualities have high patronage among the consuming public. Breeding programmes in the rice sector need to be tailored towards the end market ([Custodic et al., 2016](#)) with greater involvement of women along the crop value chain. The Women in Agriculture Division (WIAD) of the District Department of Agriculture should step up the conduct of food demonstrations on parboil rice to highlight the nutritive value of the product and create household demand for it.
- *Well organized women groups:* The presence of existing women groups engaged in Village Savings and Loans (VSL) activities, rice processing and marketing provides an opportunity for capacity building and training on rice parboiling/processing to be integrated into the value chain at minimal cost. Strengthening these groups to undertake community advocacy programme could help improve the local rice industry. Women and youth could take

advantage of the paddy available in communities and go into assembling and stocking for higher incomes.

- *Planting for Food and Jobs (PFJ)*: The presence of the government input subsidy programme provides an opportunity for women and the youth to go into rice cultivation for increased incomes and better livelihoods. The community extension component of the programme will further equip rice farmers with best agronomic and post-harvest practices leading to the production of quality paddy. Positive effects of input subsidy programmes on production and gender outcomes has been documented (Fisher and Kandiwa, 2014; Jayne *et al.*, 2018). However, Adjao and Staatz (2016) argued that in the context of West Africa, subsidies may not be needed to make the rice sector competitive. Improving efficiency in production, processing and transportation are rather effective ways of improving the system.
- *Packaging of parboiled rice*: Currently, most processors sell their rice in maxi bags (85kg). However, not all consumers can afford this quantity at a time. Poor packaging of local rice makes it less competitive in the market (Tanko, 2016). There is, therefore, the need to package in smaller sizes (5kg, 10kg, and 25kg) just as is done for imported rice so that many more people can afford with convenience. The use of quality packaging materials with good labels will also help consumers in making the right decisions.

5. CONCLUSIONS AND RECOMMENDATIONS

This study has analysed parboil rice processing in the Northern Region of Ghana with a focus on the determinants, constraints and opportunities using primary data gathered from 270 processors (150 parboilers and 120 non parboilers). The determinants of rice parboiling was analysed using the probit model while non-parametric approach was employed in analysing the constraints. Findings revealed that rice parboiling is dominantly a female enterprise though they undertake secondary income activities in the non-farm sectors (sale of processed food and retailing of foodstuffs. Jasmine and AGRA rice is the commonest varieties produced and processed but consumption is not uniform for all varieties marketed. Quality factors such as good packaging, absence of foreign materials and the relative price matter for consumers. The main significant determinants of parboiling rice processing is level of education, age and experience. Efforts to enhance smallholder processing activities should concentrate on improving training and experience level of processors.

The main revealed constraints hindering the proper development of the local rice industry and efficient participation of smallholder households in markets are inadequate technical know-how, low capacity of processing equipment, lack of grades and standards, low prices and demand, and lack of finance. The latter, appears to be more acute as many of the constraints ranked very high is interlinked with finance. For instance, low processing capacity of machinery can only be addressed effectively if funds are available to procure modern efficient mills. Financing for parboiling rice processing from formal sources was found to be non-existent and most processors had to rely on friends, relatives and VSLAs for meagre loans to support their operations. Also, weak enforcement of regulations on grades and standards for local rice in the marketplace is an issue. Investments in training and modern processing machinery can contribute tremendously in upgrading the rice value chain and guarantee the needed quality to make the product more competitive.

Based on the findings, a few recommendations are made. First, advocacy campaigns should target young women since the average age of processors is 43 years and increasing age reduces the odds of participation in rice parboiling. Failure to target and motivate young people to go into processing will affect the long-term sustainability of the parboil rice sector. Also, educated young females should be encouraged and supported with start-up processing equipment to venture into rice parboiling as a business since the sector is profitable. This has wider implications for developing economies where agriculture offers a huge opportunity and yet unemployment

continues to rise. Second, policies and advocacy campaigns should be directed towards addressing issues of limited technical know-how, low capacity of processing equipment, lack of grades and standards, pricing and financing. Technical and financial management (resource mobilisation) training should be pursued with serious gender considerations. This will greatly impact on the incomes and welfare of all actors along the parboil rice value chain. Finally, public education and policies that encourage the consumption of parboiling rice both at the household and institutional levels are recommended options for governments to help address the observed low demand for local rice. Improving quality standards of local rice, creating more awareness among target groups on the quality and product availability in local markets are advocated for. Developing pricing and marketing strategy for parboiling rice is an area that requires further research.

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